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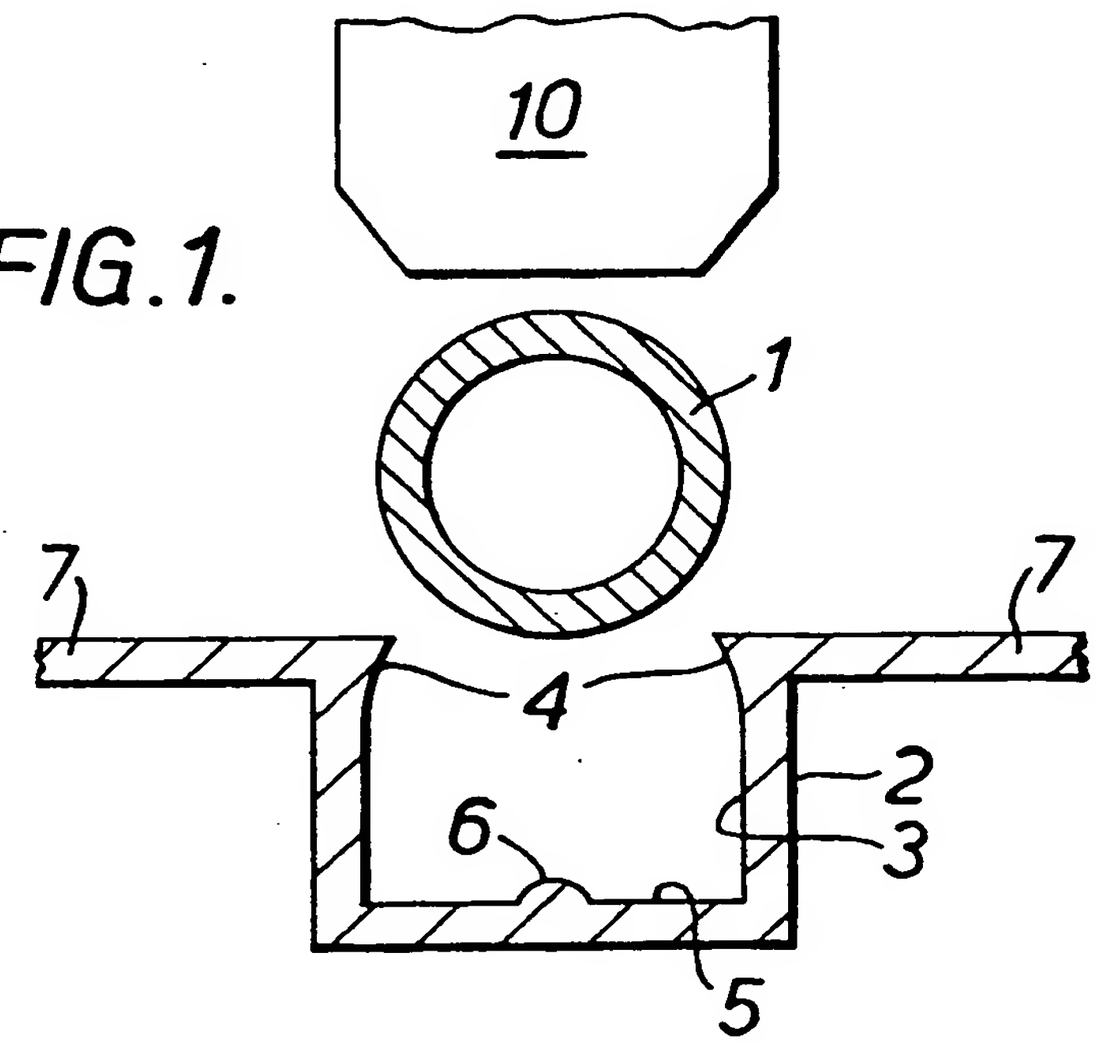
(54) Heat exchanger panel

(57) A heat exchange element for use in, for example, solar panels comprises a metal tube (1) pressed into a metal channel (2) of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor (5) and each channel side wall (3), the floor joint being spaced from each side wall joint by the corner regions of the channel.

The metal tube is preferably originally of circular cross-section and on being forced into the channel deforms to assume a re-entrant configuration at its free upper surface sufficient to promote turbulence within a heat exchange medium passing through the channel.

FIG.1.



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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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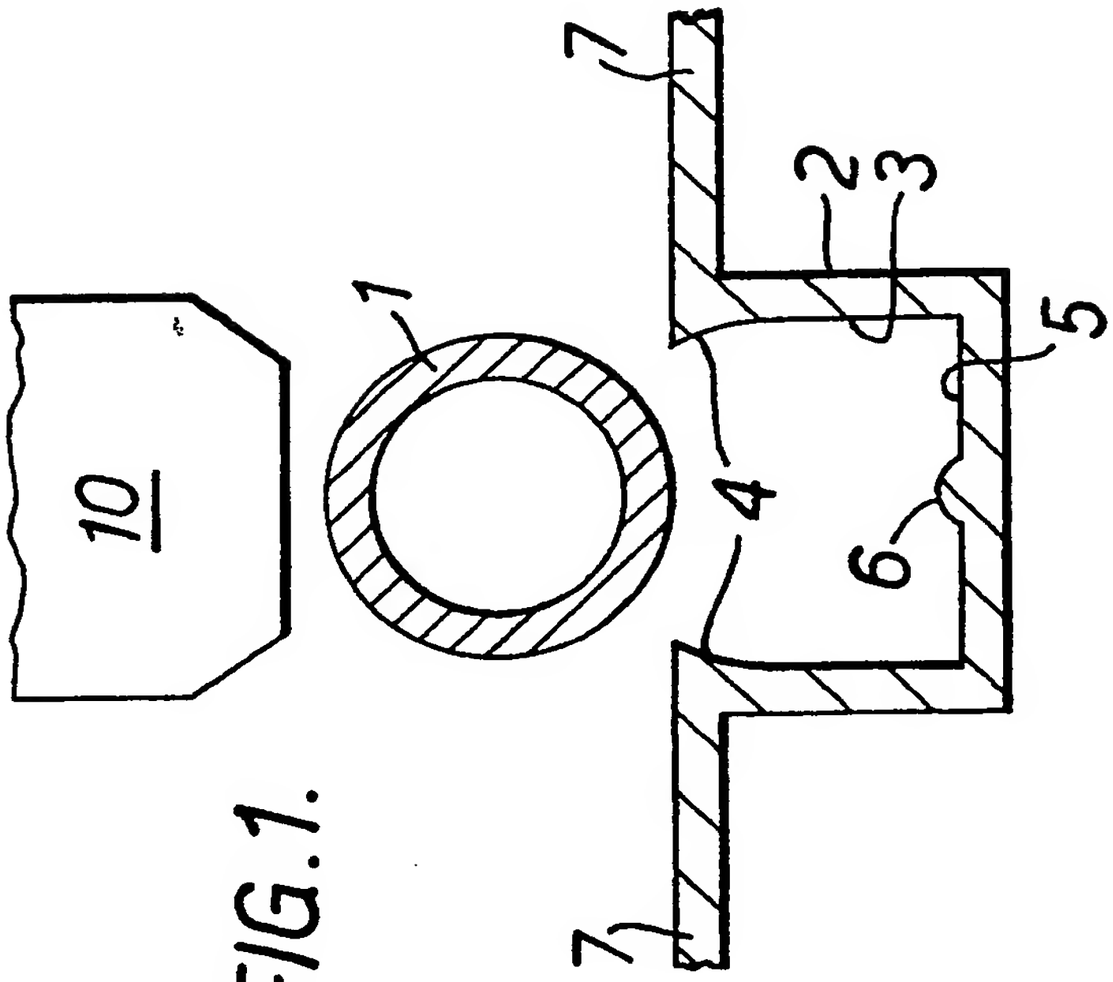

FIG.1.

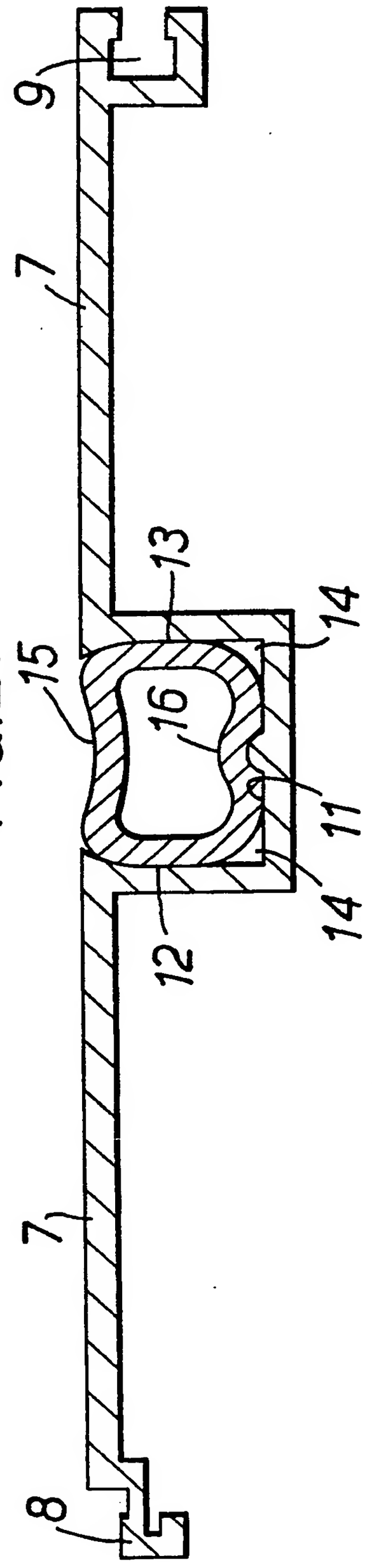

FIG.2.

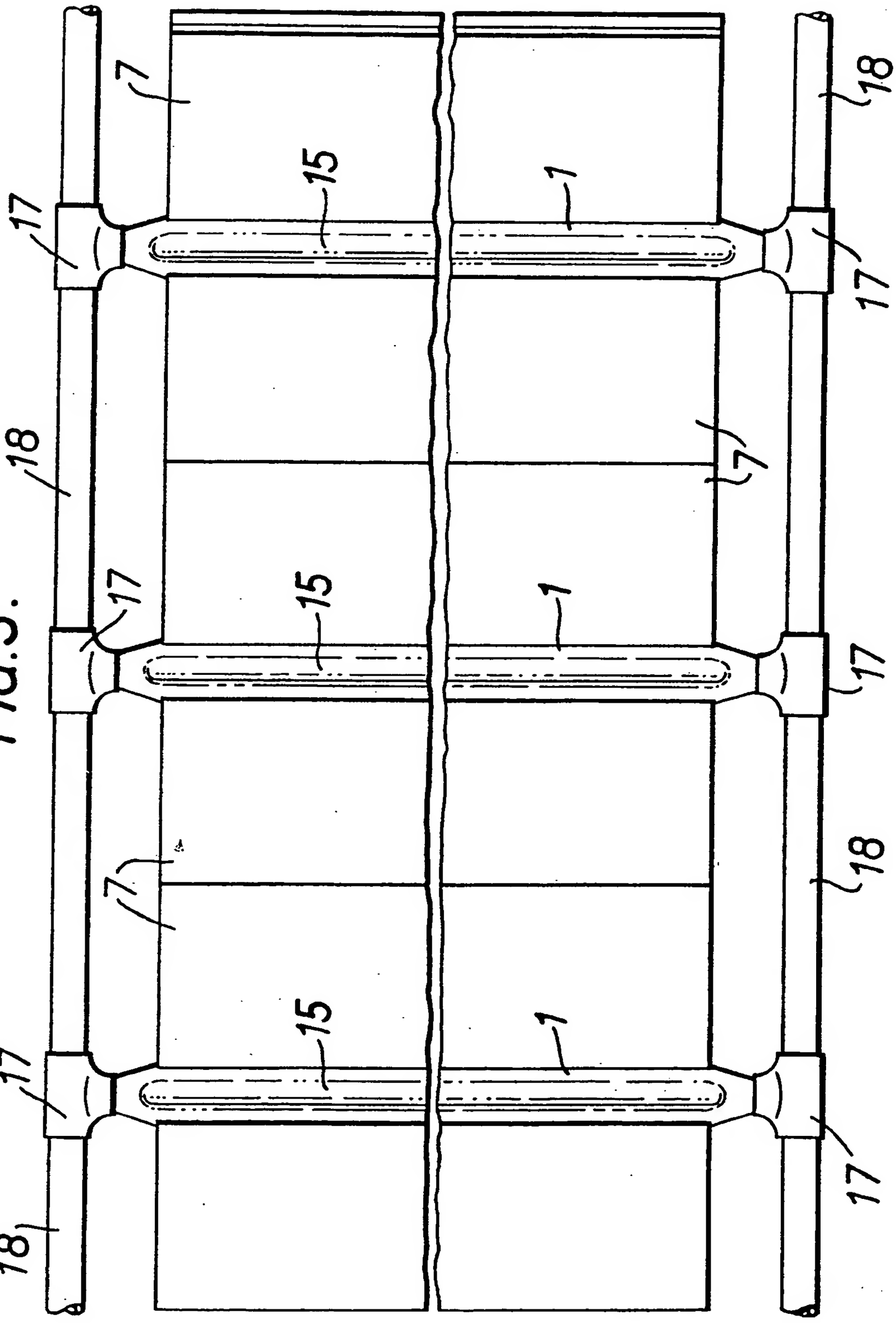

FIG.3.

SPECIFICATION

Heat exchange elements

This invention relates to heat exchange elements.

Conventionally, heat exchange elements for use, for example, as solar heating panels or domestic radiators, comprise a plurality of passageways embodied within a metal panel connected to receive and pass on a flow of heat exchange medium. Generally, these passageways are defined by hot welding or soldering together two suitably corrugated sheets; alternatively, screws or bolts have been employed for this purpose. Hot welding limits the choice of materials which can be adopted and alternative conventional means of joining are complicated and likely to lead to increased manufacturing costs.

These disadvantages are avoided by the method of construction disclosed and claimed in UK patent No. 1530925; the present invention sets out to provide an improved heat exchange element constructed generally in accordance with this method.

According to the present invention there is provided a heat exchange element comprising a metal tube pressed into a metal channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and each channel side wall, the floor joint being spaced from each side wall joint by the corner regions of the channel.

The metal tube is preferably originally of circular cross-section and on being forced into the channel deforms to assume a re-entrant configuration at its free upper surface sufficient to promote turbulence within a heat exchange medium passing through the channel.

A longitudinally extending rib may be positioned along the floor of the channel and may extend continuously along the entire floor length; alternatively several ribs may be positioned along the channel floor each one being spaced from the others. The, or each, rib may comprise a discreet step located preferably centrally across the floor width; alternatively the floor may slope upwardly from each corner to an apex approximately mid-way across the floor width.

Each side wall may be provided with an inwardly protruding lip. Preferably each lip is defined by suitable inclination of the walls from their upper margins to a point approximating to one half to one third of the wall depth.

The channelled member may be integrally formed with lateral flanges at the channel edges. Each such channelled member may comprise a single channel or several spaced channels separated by land areas. The channelled members may be extruded and consist, for example, of aluminium, stainless steel, copper or brass. The tubes may similarly consist, for example, of aluminium, stainless steel, copper or brass.

According to the present invention in another aspect a solar heating panel comprises several metal tubes originally of circular cross-section pressed one into each of a like number of metal channel members of rectangular cross-section, the tubes being pressed with sufficient force to form spaced pressure joints with the channel floor and each channel side wall, and land areas between the channel members which define heat conducting surfaces of the panel to heat heat exchange medium flowing through the tubes pressed into the channels.

According to the present invention in a still further aspect, a method of manufacturing a heat exchange element comprises the steps of pressing a pipe originally of circular cross-section into an elongated channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and channel side walls, the floor joint being spaced from each side wall joint by the corner regions of the channel.

The invention will now be described by way of example only with reference to the accompanying diagrammatic drawings in which:-

Figure 1 is a cross-section taken through a tube and channelled member during construction of a heat exchange element in accordance with the present invention;

Figure 2 is a cross-section taken through the heat exchange element illustrated in Figure 1 following construction; and

Figure 3 is a plan view from above of a solar panel consisting of several heat exchange elements in accordance with the present invention.

In Figure 1, a metal tube (1) is shown positioned above a channelled member (2) just prior to assembly. In cross-section the tube is circular and the channel generally rectangular. The external diameter of the tube is slightly less than the mouth of the channel to allow an interfence-free assembly of the tube into the channel; in addition the external tube diameter is greater than the depth of the channel. For reasons described below, the upper end of each side wall (3) of the channel is formed with a lip (4). These lips extend to approximately one third of the channel depth and are contoured so that they merge with the lower two thirds of the channel walls. Each lip surface may be straight or curved. Upstanding from the floor (5) of the channel is a longitudinally extending rib (6). The rib (6) may extend over the entire channel length or alternatively a series of spaced ribs may be provided. Whilst the rib has been illustrated as a discreet step, alternatively the floor (5) may be inclined upwardly from each corner to an apex located approximately midway across the floor width.

The channelled member is integrally formed with lateral flanges (7) having complimentary tongues and grooves (8,9) at their free edges. The member (2) is preferably extruded and is manufactured from, for example, aluminium, stainless steel, copper or brass. The tube may similarly be manufactured from one of these materials. In one construction the channelled member (2) is manufactured from aluminium and the tube from stainless steel. In any event the respective metals for the channel member and the tube are selected for minimal electrolytic action.

Positioned above the tube (1) is a suitably shaped pressing tool (10) which operates to urge the tube (1) downwardly into the channel with sufficient force to

produce, as shown in Figure 2, pressure joints (11, 12, 13) between the deformed tube and respectively the floor and each side wall of the channelled member. The floor pressure joint (11) is separated from each side wall pressure joint (12,13) by the corner regions (14) of the channel. The spacings between the channel corners and the deformed tube ensure that no overstressing of the tube or channel material occurs during the pressing operation since excess material is able to flow into the corner spacings. Additionally, the spacings ensure that the correct level of tension is maintained at the pressure joints at all times. The pressure joints retain the tube securely within the channelled member and afford a significant metal-to-metal contact area throughout the length of the channel and thus provide good heat transfer characteristics. The lips (4) help to retain the deformed tube within the channel and additionally define contact areas between the tube and the upper region of the channel.

As will be apparent from Figure 2, following the pressing operation an indent (15) is formed in the upper free surface of the tube; a similar indent (16) is formed in the tube lower surface due to the presence of the rib (6). These indents are sufficient to promote turbulence within heat exchange medium flowing through the tube thereby increasing the efficiency of the heat exchange element. Additionally they accommodate differential thermal expansion of the tube relative to the channelled member which may occur during use of the heat exchange element.

Figure 3 shows a solar heating panel comprising several heat exchange elements joined together at their side edges and connected in any convenient manner by couplings (17) to pipes (18) which convey heat exchange medium to and from the tubes (1). Intermediate tubes are connected to one another by similar couplings and pipes. As will be seen from this figure, each tube (1) protrudes a short distance beyond the ends of its channel for ease of coupling, the pressing action only being carried out over the length of the channels.

As is usual with the majority of solar heating panels, the panel surface exposed to the sun is preferably coloured black or is provided with a selected finish which absorbs solar energy in the critical frequency range and does not emit solar energy.

The preferred relationship is to have the tube diameter greater than the depth of the channel and less than the width, as mentioned above, but other proportions are possible provided a good press fit can be achieved without excessive and damaging deformation of the tube. Also, although shown as being pressed fully into the channel, it is permissible to have the exposed part of the deformed tube slightly proud of the adjacent flange.

The heat exchange elements described above have many applications, these including, in addition to solar heating panels, domestic radiators and refrigeration units; thus the heat exchange medium may comprise water, heat transfer oils or a refrigerant such as ammonia.

CLAIMS (Filed on 2/7/81)

1. A heat exchange element comprising a metal tube pressed into a metal channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and each channel side wall, the floor joint being spaced from each side wall joint by the corner regions for the channel.

2. An element as claimed in Claim 1 wherein the metal tube is originally of circular cross-section and on being forced into the channel deforms to assume a re-entrant configuration at its free upper surface sufficient to promote turbulence within a heat exchange medium passing through the channel.

3. An element as claimed in Claim 1 or Claim 2 wherein a longitudinally extending rib is positioned along the floor of the channel and extends continuously along the entire floor length.

4. An element as claimed in Claim 1 or Claim 2 wherein several ribs are placed along a channel floor each one being spaced from the others.

5. An element as claimed in Claim 3 or Claim 4 wherein the or each rib comprises a discrete step located centrally across the floor width.

6. An element as claimed in Claim 1 or Claim 2 wherein the floor of the channel slopes upwardly from each corner to an apex approximately midway across the floor depth.

7. An element as claimed in any one of Claims 1 to 6 wherein each side wall has an inwardly protruding lip.

8. An element as claimed in Claim 7 wherein each lip is defined by inclining the walls from their upper margins to a point approximating to one half to one third of the wall depth.

9. An element as claimed in any one of the preceding claims wherein the channelled member is integrally formed with lateral flanges at the channel edges.

10. An element as claimed in Claim 9 wherein each channelled member comprises a single channel or several spaced channels separated by land areas.

11. A solar heating panel comprising several metal tubes originally of circular cross-sectional pressed one into each of a like number of metal channel members of rectangular cross-section, the tubes being pressed with sufficient force to form spaced pressure joints with the channel floor and each channel side wall, and land areas between the channel members which define heat conducting surfaces of the panel to heat heat exchange medium flowing through the tubes pressed into the channels.

12. A method of manufacturing a heat exchange element comprising the steps of manufacturing a heat exchange element comprising the steps of pressing a pipe originally of circular cross-section into an elongated channel of rectangular cross-section with sufficient force to form separate pressure joints with the channel floor and channel side walls, the floor joint being spaced from each side wall joint by the corner regions of the channel.

13. A heat exchange element substantially as herein described with reference to Figures 1 and 2 of

the accompanying diagrammatic drawings.

14. A solar heating panel substantially as herein described with reference to Figure 3 of the accompanying diagrammatic drawings.

15. A method of manufacturing a heat exchange element substantially as herein described with reference to Figures 1 and 2 of the accompanying diagrammatic drawings.

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